

REMARKS/ARGUMENTS

Claims 1-2 and 7 have been amended, claims 3-6 and 8-15 remain unchanged and new claims 16-28 have been added. Thus, claims 1-28 are pending.

Claims 1-13 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al. (6,428,859) in view of Sherman (6,342,277), Chiang et al. (2002/0197402) and Machida et al. (4,732,761).

Claim 14 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al. '859 in view of Sherman, Chiang et al. '402 and Machida et al. and further in view of Qian et al. (5,571,576).

As amended, all the pending claims of the subject application comply with all requirements of 35 U.S.C. Accordingly, Applicant requests examination and allowance of all pending claims.

Formal Matters

Claim 2 has been placed in independent claim form to include all of the limitation or originally presented claim 1.

The Rejections Under 35 U.S.C. 103(a)

All of the pending claims stand rejected under 35 U.S.C. 103(a) as being unpatentable in view of Chiang et al. (the primary reference) in combination with one or more other secondary references including Sherman (6,342,277). The rejections are respectfully traversed.

The Chiang et al. reference teaches an atomic layer deposition (ALD) process that uses kinetic energy associated with high energy ion bombardment to drive the deposition process. See col. 5, lines 59-65; see also col. 6, lines 60-62. During the Chiang et al. ALD process the substrate is exposed to high energy ions that deliver the necessary activation energy to the near surface atoms and adsorbed reactant(s) via collision cascades. Col. 5, lines 59-65. The substrate is maintained at a relatively low temperature so the ALD reactants do not thermally react with any appreciable rate or do not react at all. Col. 6, lines 21-27. Chiang et al. refers to this ion-induced ALD method as MII-ALD (modulated ion-induced atomic layer deposition). Col. 6, lines 36-38.

Claim 1 (and its dependents)

In contrast, the invention of claim 1 primarily relies on thermal energy to drive an ALD reaction between a first silicon-containing reactant and oxygen radicals formed from a second reactant. Claim 1 has been amended to clarify this distinction and Applicants respectfully assert that Chiang et al. teaches away from this aspect of the invention of claim 1.

Applicants further note that a combination of the Chiang et al. and Sherman references also does not result in the invention of claim 1. For example, Sherman does not teach biasing the substrate to promote sputtering during the ALD process as recited in claim 1. To the extent the Examiner believes this concept is taught or suggested by Chiang et al., Applicants note that Chiang et al. biases the substrate in order to effect an ion-induced reaction mechanism at the substrate's surface which is driven by kinetic energy as opposed to thermal energy. Thus, if a skilled artisan were to look to the teaching of Chiang et al. and bias the ALD reaction taught in Sherman in the manner suggested by Chiang et al., the resulting ALD reaction would be driven by kinetic energy and not by thermal energy as recited in claim 1. Accordingly, Applicants respectfully assert that claim 1, as amended, is patentable over the combination of Chiang et al. and Sherman. Applicants also assert that all claims dependent on claim 1 are patentable over the cited art for at least the same reason as claim 1.

Claim 2 (and its dependents)

Claim 2, which has been placed in independent claim form to include all of the limitations of originally presented claim 1, recites that "the average atomic mass of all atomic constituents in the second reactant (from which the oxygen radicals are generated) is less than or equal to an average atomic mass of oxygen." Claim 2 further requires biasing the substrate while it is exposed to the second reactant in order to promote a sputtering effect.

In contrast, the MII-ALD approach taught by Chiang et al. which biases the substrate so that high energy ions deliver the necessary activation energy (kinetic energy) to drive the reaction. Chiang et al. teaches that this is done by using relatively heavy inert gases such as Ar, Kr, Ne and Xe. All of these elements have an atomic mass that is higher than the average atomic mass of oxygen. Accordingly, Chiang et al. teaches away from the invention of claim 2. Furthermore, Sherman does not make up for this deficiency in Chiang et al. since Sherman does not teach biasing the substrate at all while the substrate is exposed to the second

reactant. Accordingly, Applicants respectfully assert that claim 2 is patentable over the combination of Chiang et al. and Sherman. Applicants also assert that all claims dependent on claim 2 are patentable over the cited art for at least the same reason as claim 2.

Claim 15 (and its dependents)

Similar to claim 2, claim 15 also recites that "the average atomic mass of all atomic constituents in the second reactant (from which the oxygen radicals are generated) is less than or equal to an average atomic mass of oxygen" and that the substrate is biased while it is exposed to the second reactant in order to promote a sputtering effect. Thus, Applicants respectfully assert that claim 15, and all claims dependent on claim 15 are allowable over the combination of Chiang et al. and Sherman for at least the same reason as claim 2. Applicants further note that claim 15 recites that the substrate be maintained at a temperature of between 300-800°C during the growth of the silica glass film. Chiang et al. teaches away from this aspect of the invention of claim 15 because Chiang et al. teaches that the substrate be maintained at a relatively low temperature so the ALD reactants do not thermally react with any appreciable rate or do not react at all. Col. 6, lines 21-27. Thus, the invention of claim 15 is believed to be patentable over the combination of Chiang et al. and Sherman for at least this additional reason.

New Claims

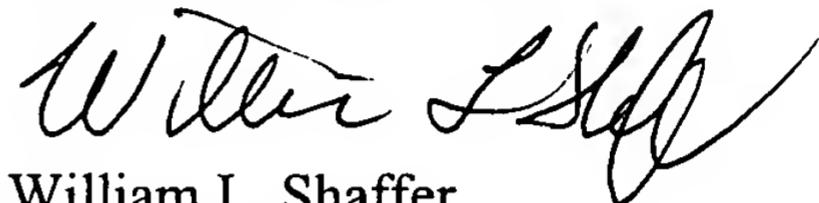
New claims 16-28 have been added to secure an appropriate scope of protection for the present invention. Support for the claims exists in the Specification as originally filed. For example, support for monitoring an amount of oxidation that occurs during the converting step and stopping the converting step when a determination has been made that full oxidation has occurred exists at least at page 6, paragraph [0023]. Support for the monitoring step comprising detecting radiation reflected from the surface of the substrate, comparing interference patterns to previous patterns that represent a fully oxidized film and generating a signal that can be used to endpoint the converting step also exists at least at page 6, paragraph [0023]. And support for the limitation of maintaining the substrate at a temperature of at least 300°C during the growth of the silica glass film exists at least at page 7, paragraph [0027].

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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